Getting Started with the BEE4 Hardware Platform

Revision B01, Firmware v1.0

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Revision History

Version	Date	Author	Description
1.1	12/20/11	F. Fatollahi-Fard	Updated Release for Board Revision B01 and Firmware v1.0
1.0	06/16/11	F. Fatollahi-Fard	Initial Release for Board Revision A01 and Firmware v0.4

Introduction

This document is intended for first-time users of the BEE4 Hardware Platform to help familiarize them with the basic operation of the system. By following the brief procedures outlined below, the reader will observe how to use the BEE4 Host Embedded Platform to power on and monitor the Main Processing Board, load the precompiled reference design provided with the BEE4 system onto the hardware fabric, and interact with several basic system components.

Overview of BEE4 Hardware Platform

The BEE4 Hardware Platform is a high-performance FPGA-based computing, prototyping, and emulation platform featuring the Xilinx Virtex-6 family of FPGAs. There are two fundamental components that make up the BEE4: the *Embedded Control Host (ECH)* and the *Main Processing Board (MPB)*.

The Embedded Control Host is comprised of a host PC module that controls power to the main processing board and provides many monitoring interfaces to the main processing module. This Embedded Control Host is essentially a regular PC that provides an interface to the BEE4 configuration logic.

The Main Processing Board is comprised of four Xilinx Virtex-6 FPGAs as well as various high-speed components, including DDR3 DRAM, Gigabit Ethernet, QSFP, and FMC.

Using the BEE4 Hardware Platform

The following instructions will show how to use the Embedded Control Host to use the BEE4.

Installing the BEE4 Platform

Install BEE4 into its physical location. Connect the VGA connector to an external monitor and connect the Embedded Control Host Ethernet port, both on the back side of the BEE4 as shown Figure 1. Connect a keyboard and mouse to the USB ports. Only self-powered or low power devices may be used on BEE4 (high power, bus-powered devices must be behind a self-powered hub). Once those steps are complete, connect the power cable and turn the power supply on. This will provide power to the Embedded Control Host, as demonstrated by the BEE4 Logo coming on the LCD module and the green LED on the hard drive bay lighting up (See Figure 2 for a picture of the front panel). However, this will **NOT** power Main Processing Board.

Once the Embedded Control Host has booted up, the logon prompt will appear on the connected monitor. Log into the Embedded Control Host with the following information:

Username: `BEEcube`

Password: `BEEcube`

Figure 1 - BEE4 Back Panel

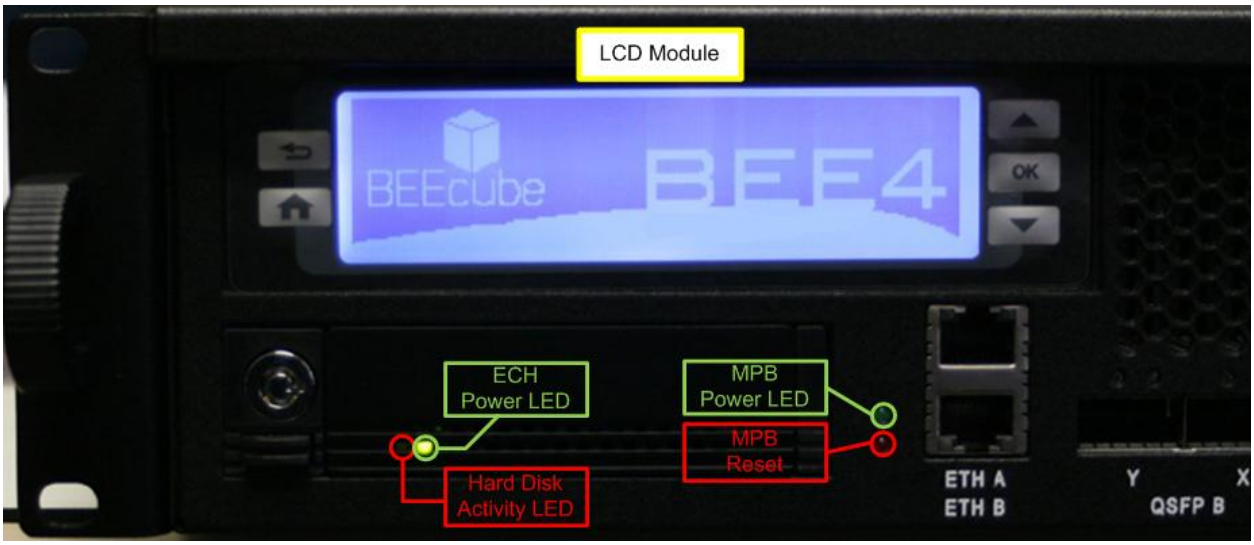

Figure 2 - BEE4 Front Panel

Powering On the Main Processing Board

Once logged into the Embedded Control Host, open a command prompt/terminal. To power on the Main Processing Board, type:

```
BEE4Control -1
```

This will initialize and power on the Main Processing Board, making it ready operation. This will also turn on the Green Power LED located on the front panel (see Figure 2), and you will hear the main fans start spinning.

NOTE: The user is responsible for turning on power to the main board – the main board is protected from any damage if operations are performed without power being delivered, but monitoring and programming results will be undefined.

Controlling the Main Processing Board

Now that the Main Processing Board is powered on, controlling the status of the Main Processing Board is now possible. Available controls include monitoring the voltages of all power supplies, monitoring the temperature of the BEE4 at each FPGA, scanning the JTAG chain, high-speed FPGA programming via SelectMAP, and sending user-defined resets to the FPGAs.

Voltage Monitoring

Provided on the Embedded Control Module is a script that will read out every voltage on provided on every voltage rail. To run this script, type at the command prompt/terminal:

```
vmon.sh
```

This will print the current voltage on all power supplies on the main board and for each FPGA.

Temperature Monitoring

Provided on the Embedded Control Module is a script that will read out the temperature of each FPGA. To run this script, type at the command prompt/terminal:

```
tmon.sh
```

This will print the internal temperature in Celsius of each FPGA.

JTAG Chain

The Main Processing Board provides a JTAG chain connecting all four of the FPGAs, which is controlled by a standard Xilinx Platform USB II module available to the Embedded Control Host. This makes it possible to use any Xilinx application which relies on the JTAG port. An example of the JTAG chain for the BEE4 as it appears within iMPACT is shown in Figure 3.

NOTE: The Main Processing Board must be turned on prior to scanning the JTAG chain, or iMPACT will report errors.

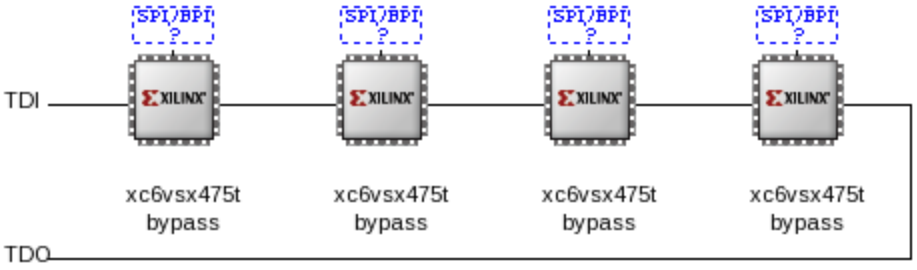

Figure 3 - Example BEE4 JTAG Chain

Programming the BEE4

In order to program the BEE4, the Embedded Control Module features a high-performance interface to each FPGAs SelectMAP port, which can program each FPGA within seconds. The following tool is provided with BEE4 for this purpose:

NOTE: The Main Processing Board must be turned on prior to programming the FPGAs or this command will have no effect.

```
SelectMAP {A,B,C,D} {PATH TO BIN FILE}.bin
```

The `{A,B,C,D}` in the executable call is the FPGA selector. It designates which FPGA is being programming. It is only possible to can only program **one FPGA** with each call to this executable, so only one FPGA can be selected to program with each call.

It should also be noted that the executable takes a BIN file. This is file specifically designed to be used with SelectMAP. A regular BIT file cannot be used to program the BEE4 FPGAs via SelectMAP.

Each FPGA can be checked to see which ones are programmed. To do so, the following command may be run:

```
SelectMAP -s {A,B,C,D}
```

Powering off the BEE4

The Main Processing Board can be turned off by using the following command at the command prompt/terminal:

```
BEE4Control -0
```

This will power off the Main Processing board, as indicated by the Green Power LED located on the front panel turning off.

NOTE: Since the Embedded Control Host on BEE4 runs at all times, the BEE4 cannot simply be unplugged or switched off from the back panel without properly shutting down the operating system on the Embedded Control Host. The Embedded Control Host will be powered off when

both the LCD module is powered off and the green LED on the hard drive bay is powered off as well as an indication of when it is safe to remove power.

Running the Precompiled Reference Design

The BEE4 Hardware Platform is delivered with a reference design preloaded on the Embedded Control Host. The following steps will load this design onto BEE4 and allow some simple interaction with the system.

1. Power on the BEE4 system using the above steps and verify the MPB Power Light is on.

2. Open `minicom` to the port(s) you would like to use. Configurations are provided named `usb{0,1,2,3}`, which corresponds to FPGA A, B, C, and D, respectively.
   For example, if you would like to open the UART to FPGA A, type in the terminal:

   ```
   $ minicom usb0
   ```

NOTE: Be sure to *close* the serial terminal when not in use, as it will interfere with the BEE4 remote data transfer service. To do so, press `<Ctrl> + A, X`. This will prompt you if you want to close `minicom`. Select `Yes` to close the port.

3. Open another command prompt and program the FPGA(s) using SelectMAP. The bin file is located in `/opt/BEEcube/share/gs101_<device>.bin`. The device string corresponds to the type of FPGA device on your BEE4 system, which can be any one of `lx240t`, `lx365t`, `lx550t`, `sx315t`, or `sx475t`.
   For example, to program FPGA A on an SX475T system, type in the terminal:

   ```
   $ SelectMAP A /opt/BEEcube/share/gs101_sx475t.bin
   ```

   Which should output:

   ```
   SelectMAP
   Opening Bin File: /opt/BEEcube/share/gs101_sx475t.bin
   Initiating FPGA A Programming
   Programming FPGA A is successfully complete.
   ```

4. Once the FPGA is programmed, the serial terminal from step 2 will reveal a limited version of the BEE4 NectarOS™ shell. You should see the following output on the console (the FPGA letter may vary based on your connections):

   ```
   ********************
   * BEE4 GS101 Demo *
   ```

```
******************

Type 'help' for help
Type '?' for a list of available commands


FPGA A %
```

5. Run the command `help`. This will familiarize you with how to use the NectarOS™ shell.

6. Run the command `bee4_info`. The system information stored into the EEPROM during manufacturing will be printed to the screen. You should see something like this:

```
EEPROM contents:
 Model    - BEE4-SX475T-2C
 Serial   - 1000-001
 MAC      - 00-50-C2-95-E0-00
 FPGA     - A
 Revision - B01
```

7. Run the command `set_leds 1 1 1 1`. This will turn on all of the QSFP LEDs on the front of the BEE4. The arguments correspond to each LED from left to right.

8. At this point, you are free to experiment with all the commands available in the shell. Pressing `?` at an empty prompt will auto-complete from the list of available commands and a short description of each command. Pressing `<Tab>` at an empty prompt will auto-complete from the list of available commands. Pressing `<Tab>` once a valid command has been typed (but before pressing `<Enter>`) will list the arguments accepted by the command.

9. You can also demonstrate the soft reset capability from the Embedded Control Host by running the following on a new command line (remember to call this from a separate command line and not within the FPGA terminal) :

```
BEE4Control –r A
```

WARNING: Make sure to *close* the serial terminal when not in use, as it will interfere with the BEE4 remote data transfer service. To do so, press `<Ctrl> + A, X`. This will prompt you if you want to close `minicom`. Select `Yes` to close the port.

Conclusion

This document familiarized the first-time user with basic operation of the Embedded Control Host on the BEE4 as well the Main Processing Board on the BEE4. It also provided a simple reference design for use on the BEE4. Much more detailed information about the complete hardware architecture can be found in the *UM103: BEE4 Hardware Platform User Manual*.